Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 150 (2016) 1056 – 1062

Procedia Engineering

www.elsevier.com/locate/procedia

International Conference on Industrial Engineering, ICIE 2016

Mathematical Simulation of Nonlinear Problem of Three-Point Composite Sample Bending Test

I.B. Badriev[a,*], M.V. Makarov[a,b], V.N. Paimushin[a,b]

[a] *Kazan Federal University, 18 Kremlyovskaya Street, Kazan 420008, The Russian Federation*
[b] *Kazan National Research Technical University, 10 Karl Marx Street, Kazan 420111, The Russian Federation*

Abstract

This study is devoted to numerical analysis of the geometrically and physically nonlinear problem of three-point bending test of laminated fiber-reinforced composite samples with rectangular cross-section. The problem is formulated by using relationships based on describing the displacement vector for an arbitrary point on the beam (Timoshenko model). For numerical solution of the problem, the finite sums method is used. In accordance with this method, the initial equations are reduced to integro-algebraic equations, which are then approximated by a collocation method using Gauss nodes. Implemented numerical enables a very accurate description of solution having large gradients change at very short sections. Buckling of the beam under transverse load has been studied by altering the loading parameter.

Peer-review under responsibility of the organizing committee of ICIE 2016

Keywords: Mathematical simulation; geometrically and physically nonlinear problem; three-point bending; laminated fiber-reinforced composite; buckling

1. Introduction

In recent years, new construction materials have been frequently used in the aerospace industry, allowing to come up with the designs for various applications with highly demanding characteristics. Among other composite materials occupy a special place. With its high specific strength and stiffness, composites also allow to design structures with the required mechanical properties depending on the purpose of their design and operation conditions (see., e.g., [1–5]). In this paper as an advancement of the research described in the paper [6], we consider the

* Corresponding author. Tel.: +7-919-630-7659;
E-mail address: ildar.badriev1@mail.ru

Peer-review under responsibility of the organizing committee of ICIE 2016
doi:10.1016/j.proeng.2016.07.214